B&K PRECISION®

Operating Manual

Model 6010/6011/6012/6013

Highspeed Programmable Attenuator

Before use

Thank you for your purchase of the Highspeed Programmable Attenuator model 6010/6011/6012/6013.

Please check the following prior to use of this equipment.

1. Ambient temperature and ventilation

The operating temperature of this equipment is 0°C to +40°C. Be careful not to obstruct air flow by placing objects near the cover's ventilation hole and fan.

2. Power supply voltage

Check the power supply voltage before connecting the power cord of this equipment to a power outlet. This equipment may be used with power supply voltage of 90 to 130V or 180 to 250V. The equipment may fail if the power supply voltage is outside of these ranges.

3. Do not apply excessive voltage levels

Do not apply a voltage level exceeding ±20V to the TRIG IN input or READ CLOCK IN input.

4. Power cable

To avoid electric shock, use the provided power cable and connect it to a 3-prong power outlet.

5. Accessories

Please check that you received the following accessories:

1 Operating manual
1 Power cord
1 Fuse
1 Software Installation CD
1 RS-232C cable

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1. Overview

The Highspeed Programmable Attenuator Models 6010/6011/6012/6013, the **6010 series**, provide attenuation of up to 80dB in steps of 0.05 dB and a minimum program step time of 2μs. The four models cover a wide frequency range of 1.5GHz – 13.5GHz. The 6010 series offers high accuracy, stability and many features, yet are easy to use. Due to the favorable price/performance ratio, the 6010/6011/6012/6013 attenuators are put to use in a diverse range of applications.

Features:

- **2 μs per word maximum switching speed (program readout clock speed) when in program mode**
- **Wide attenuation range of 80dB for program and manual mode**
- **Minimum attenuation step size of 0.05dB**
- **Program run modes**

  The program can be executed in free run, burst, or gate mode.

FREE	The program comprising of attenuation data and Pause information is run continuously without the need of external trigger signals.
BURST	Each rising edge of the trigger signal applied to TRIG IN triggers execution of the program memory. Pause Time is ignored.
GATE	The program (readout period) followed by the pause time is run while the TRIG IN signal is TTL high.

- **Pause Time can be defined by number of clock cycles or by absolute time value**

  The Pause Time is the time interval in between program steps. It can be set in one-clock increments or as a time value in 100 μs steps.

- **Software for creation of attenuation profiles**

  The 6010 series includes software to create and edit attenuation profiles and transfer the attenuation data points via the RS-232C interface to the instrument's internal memory (RS-232C communication cable is included.) The Software is intuitive and Windows98/Me/2000/XP/Vista compatible. The program's large capacity and high resolution (memory depth of 128k words, 8 bits per word) and support of clock frequency of up to 500 kHz makes the 6010 series an ideal tool for a broad range of applications.

2. Specifications

2.1 Performance

	Model 6010	**Model 6011**
Frequency range	1.5 to 4.5 GHz	3.0 to 9.0 GHz
VSWR	< 1.5 @ 2 to 4 GHz < 2.0 @ 1.5 to 4.5 GHz	< 1.7 @ 4 to 8 GHz < 2.2 @ 3 to 9 GHz
Insertion loss (0 dB setting)	< 2.3 dB @ 2 to 4 GHz < 2.6 dB @ 1.5 to 4.5 GHz	< 3.0 dB @ 4 to 8 GHz < 3.3 dB @ 3 to 9 GHz
	Model 6012	**Model 6013**
Frequency range	4.5 to 13.5 GHz	1.95 to 5.85 GHz
VSWR	< 1.8 @ 6 to 12 GHz < 2.2 @ 4.5 to 13.5 GHz	< 1.6 @ 2.6 to 5.2 GHz < 2.1 @ 1.95 to 5.85 GHz
Insertion loss (0dB setting)	< 3.5 dB @ 6 to 12 GHz < 3.8 dB @ 4.5 to 13.5 GHz	< 2.6 dB @ 2.6 to 5.2 GHz < 2.9 dB @ 1.95 to 5.85 GHz

Attenuator

Setting range	0 to 80 dB
Setting resolution	0.05 dB
Accuracy	±0.5dB @ 0 to 10dB
(at center of frequency range	±0.8dB @ >10 to 30dB
and +10dBm input)	±1.0dB @ >30 to 50dB
	±1.5dB @ >50 to 64dB
	±2.0dB @ >64 to 74dB
	±3.0dB @ >74 to 80dB
Impedance	50 Ω nominal
Filter	1 µs to 3 ms, 1-3 step
Maximum input level	100 mW, either CW or peak power
Input damage level	0.8W average power
	20W peak power of 1 µs pulse
Input/output connectors	SMA

Readout clock input

Input level	TTL
Maximum frequency	500 kHz
Input impedance	10 kΩ ±5%
Minimum pulse width	200 ns (for TTL low and high)

Input damage level	±20V (DC + peak AC)
Connector	BNC
Trigger input	
Input level	TTL
Input impedance	10 kΩ ±5%
Minimum pulse width	> 1 μs
Input damage level	±20V (DC + peak AC)
Connector	BNC
SYNC output	
Output level	TTL
Rise / Fall time	< 100ns
Output impedance	approximately 100 Ω
Connector	BNC

Functions

Attenuation mode	Manual and Program
Program mode	
Program length	8 to 131072 words, (can be set in one word steps)
Readout clock	
Internal clock	100 Hz to 500 kHz, 1-2-5 step
External clock	DC to 500 kHz
Pause Time	
Clock setting	0 to 65535 clocks adjustable in 1 clock cycle increments
Time setting	0 to 6.5535sec (in 100μs increments)
Program execution mode	Free, Burst, Gate
Non volatile program memory	Program data is automatically saved when power is turned off.

Software for creating attenuation programs

Supported OS	Windows98/Me/2000/XP/Vista
Waveform creation	
Standard waveforms	Sine, Triangle, Square, Ramp, sin x/x, (1- ε^{-ax}), ε^{-ax} and DC
Parameters	Data length, Amplitude, Offset, Number of Cycles, Phase, Duty Cycle (only Square wave), Zero cross (only sinX / X), Damp Factor
Straight line	Connect two or multiple points with a straight line
Math Functions	+, -, ×, Clipping, Absolute, Mirror, Resize, Offset
Editing options	Cut, Copy, Paste, Undo, Delete
File menu	New, Open, Close, Save, Save as, Data import, Data export, Print, Printer setup, Transmit, Exit

Other

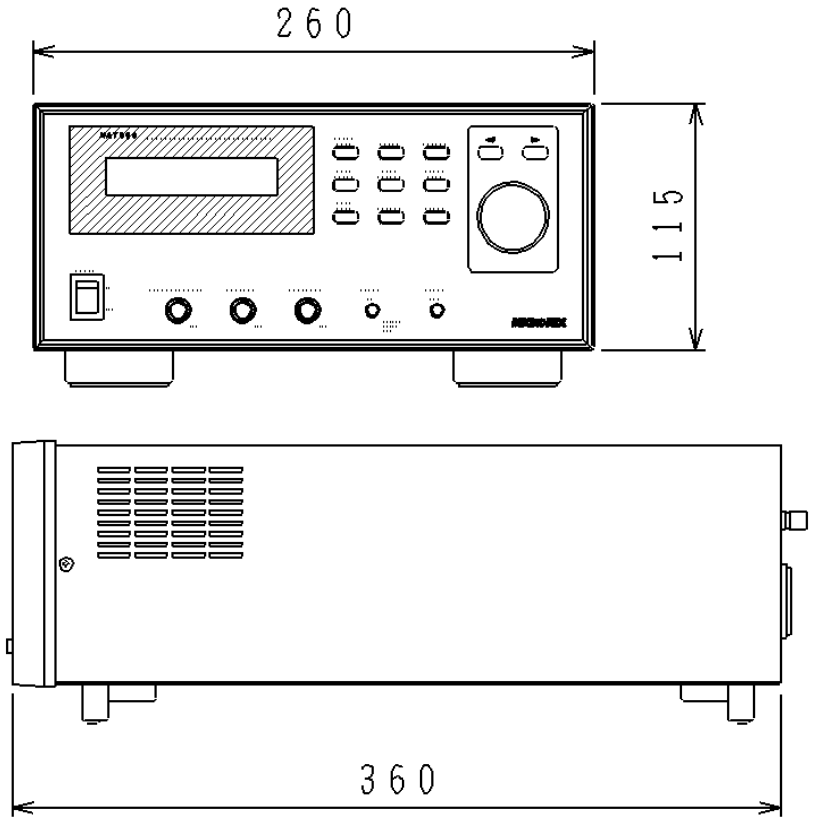
Display	LCD (backlit. 2 rows of 20 characters)
Interface	
RS-232C	Standard
Baud rate	2,400 to 57,600
GPIB	Standard

General

Operating temperature	0 to 40° C (Specifications guaranteed at 23 ±5° C)
Operating humidity	less than 40° C / 80%RH (Guaranteed at less than 28° C / 80%RH)
Storage temperature	-10 to +60° C / less than 80%RH
Power Supply	90 to 132VAC / 180 to 250VAC (selectable by a switch located on rear panel)
Weight	approx. 10 lbs (4.5kg)
Dimensions	8.11" (W) × 4.53" (H) × 14.18"(D) (excluding projections) 260 (W) × 115 (H) × 360 (D) mm (excluding projections)
Standard accessories	Operating manual (1pc), Power cord (1pc), Fuse (1pc), Installation CD for creating attenuation profiles (1pc), RS-232C cable (1pc)

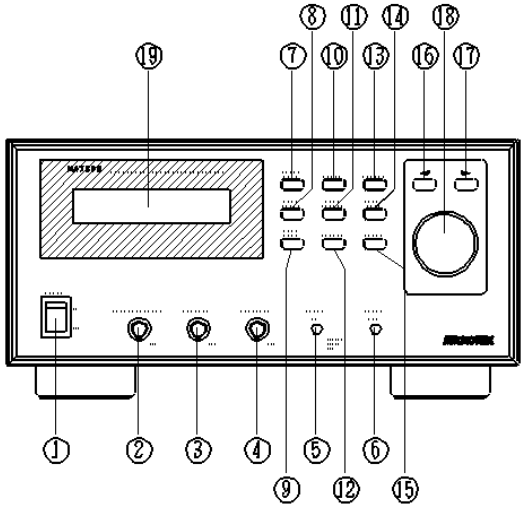
2.2 External appearance and dimensions drawing

Units in mm



3. Description of panels

3.1 Front panel



①POWER

- Main power switch.

②READ CLOCK IN

- READ CLOCK input terminal. Apply an external clock signal with a maximum of 500 kHz to this input.

③TRIG IN

- Apply a TTL level trigger signal to this terminal when in BURST or GATE mode. Readout of attenuation data is triggered by rising edge (BURST mode) or when signal is TTL high (GATE mode).

④SYNC OUT

- TTL level Output signal, indicates start of readout period when in program mode. The Sync signal is programmable, see DLxxxx command in chapter 6 for details

⑤ATTEN IN/OUT

- Attenuator's input/output terminal.

⑥ATTEN OUT/IN

- Attenuator's output/input terminal.

CAUTION: Do NOT apply an input signal to both ATTEN IN/OUT terminals at the same time.

:⑦ATTEN MODE

- Key for selecting manual or program mode.

⑧READ CLOCK

- Key for selection of program memory read clock frequency.

⑨READ MODE

- Key for selecting BURST, GATE or FREE program execution mode.

⑩ATTEN

- Key for setting attenuation values in manual mode.

⑪PROGM LENGTH

- Key for setting the program memory length.

⑫SET UP

- Key for interface configuration.

⑬FILTER

- Key for setup of attenuator switching response time.

⑭PAUSE TIME

- Used for setting of program pause time.

⑮ENTER

- Used to confirm front panel entries

⑯ ◄

- Move cursor left.

⑰ ►

- Move cursor right.

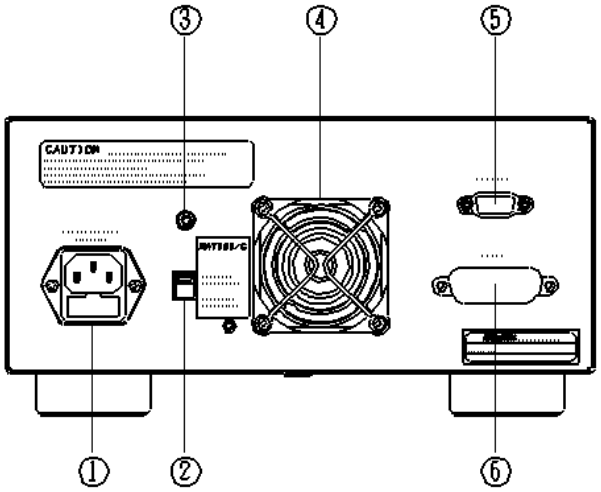
⑱ROTARY KNOB

- Increases or decreases the displayed numeric value. Turn clockwise to increase and counterclockwise to decrease values.

⑲LIQUID CRYSTAL DISPLAY

- Letters can be displayed in two lines (up to 20 letters per line). The settings of all parameters such as ATTN MODE, READ CLOCK, PROGM LENGTH, READ MODE and FILTER are displayed.

3.2 Rear panel



①AC line input

- Connector for supplying AC power to the instrument. Use the provided power cord to connect to a power outlet. The AC voltage range is 90 - 130V or 180 - 250V. Make sure that the supplied voltage is within this range. The AC receptacle also incorporates a fuse holder. Use a slow blow fuse of 1.5A for 90 - 130VAC, or a slow blow fuse of 0.8A for 180 - 250VAC operation.

②AC line voltage select switch

- The switch is used to select 90 - 130VAC or 180 - 250VAC operation. Make sure your selection matches the supply voltage in your area

③Earth terminal for protection

- For safety reasons, if the power outlet is not of 3-prong type, make sure to connect this terminal to Earth Ground.

④Fan motor

- Do not obstruct the airflow by placing objects in the vicinity of the vent hole.

⑤RS-232C

- Connector for RS232C communication. Communication with a PC is performed at 2,400 - 57,600 bps.

⑥GPIB

- Connector for GPIB communication.

4. Operation

4.1 Manual and program mode

- Select the attenuator control mode. The cursor on the screen moves to [MANUAL] or [PRGM] at positions indicated below when the <ATTN MODE> key is pressed.

[MANUAL] mode screen

```
MANUAL          23.45dB
                10μs
```

[PRGM] mode screen

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Toggle between [MANUAL] and [PRGM] mode by turning the rotary knob

① [MANUAL] mode

The attenuation value set by <ATTEN> remains active.

② [PRGM] mode

The attenuation value is controlled by the program stored in internal program memory.

A program of up to 128K words can be stored. (An attenuation program can be created and downloaded to the instrument's memory using the provided attenuation program software or by sending remote commands and data from a custom program)

4.2 ATTEN

- Set the attenuation level. The cursor moves to the xx.xx dB position when the <ATTEN> key is pressed. This is valid in [MANUAL] mode only.

```
MANUAL          23.45dB
                10μs
```

- Adjust the attenuation value within the range of 0.00dB - 80.00dB using the cursors and rotary knob. Press the < key to move towards the most significant digit and press the > key to move towards the least significant digit.

4.3 FILTER

- Set the attenuator switching response time. The cursor moves to the position indicated below when the <FILTER> key is pressed. This parameter can be set in either [MANUAL] mode or [PRGM] mode.

[MANUAL] mode example:

```
MANUAL          23.45dB
                10μs
```

[PRGM] mode example:

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Filter Response time can be entered in 1-3 steps in the range of 1 μs – 3 ms using the rotary knob.

Note: Use the built-in filter to reduce switching transients. To set the filter response time appropriately in relationship to the readout clock, a value of 1/2 to 1/8 of the clock period is recommended.

4.4 READ CLOCK

- Select the program memory read clock. The cursor moves to the position indicated below when the <READ CLOCK> key is pressed. This parameter is valid in [PRGM] mode only.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- [MANU], [EXT], [100Hz] - [500kHz] can be selected using the rotary knob.

① When [MANU] is selected, one clock cycle can be generated by pressing the <ENTER> key.
② When [EXT] is selected, the signal applied to terminal READ CLOCK IN is used as the clock.
③ When the range of [100Hz] - [500kHz] is selected, the internally generated clock is used.

4.5 PRGM LENGTH

- Set the program memory length. The cursor moves to the position indicated below when the <PRGM LENGTH> key is pressed. This is valid in the [PRGM] mode only.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Move the cursor using cursor keys, and set a value in the range of 8 - 131072 using the rotary knob. It is provided, however, that the upper limit depends on the date length in the program memory.
- Press the < key to move towards the most significant digit and press the > key to mode towards the least significant digit.

4.6 PAUSE TIME

- The pause time is defined as the interval between readout periods. The first pause time is the time interval between the first and second readout period.

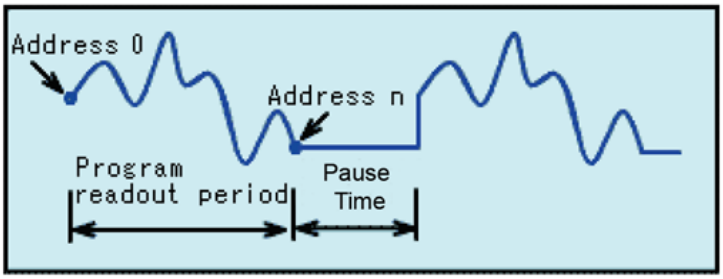


Figure 1: Readout period and Pause time

The screen below appears when the PAUSE TIME key is pressed. Highlight and select one of the parameters [TIME], [CLOCK] or [OFF]. The current setup is displayed in the right upper part of the screen. This parameter is valid in the [PRGM] mode only.

```
PAUSE:  TIME  0.0000s
TIME  CLOCK  OFF
```

Note: During the Pause time, the last attenuation value in the program remains active.

① When [TIME] is selected, the main screen is displayed and the cursor moves to the position indicated below.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Move the cursor using the cursor keys and set a value in the range of 0 s - 6.5535 s using the rotary knob. The cursor moves towards the most significant digit when < is pressed and towards the least significant digit when the > key is pressed. Values can be set with 100 μs resolution.

② When [CLOCK] is selected the main screen is displayed and the cursor moves to the position indicated below.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Move the cursor using the cursor keys and set a value in the range of 0 - 65535 using the rotary knob. The cursor moves towards the most significant digit when < is pressed and towards the least significant digit when the > key is pressed.
- Note: The applicable clock signal is what was selected by READ CLOCK.

③ When [OFF] is selected, the main screen is displayed.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Setting the Pause time to OFF is equivalent to setting the parameters [TIME] or [CLOCK] to zero.

4.7 READ MODE

- Select the program read mode. The cursor moves to the position indicated below when the <READ MODE> key is pressed. This is valid in [PRGM] mode only.

```
PRGM  500KHz  L:131072
P:6.5535s  FREE   10μs
```

- Select one of 3 possible modes [FREE], [GATE] and [BURST] using the rotary knob.

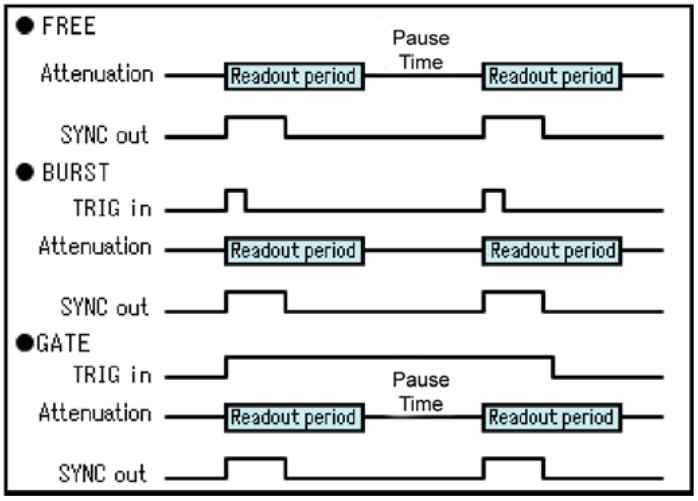


Figure 2: Readout period and Pause time for the 3 operating modes

① When [FREE] is selected, the program is read (i.e., run) and a delay of the pause time is created. This is repeated continuously.

② When [GATE] is selected, the program read and pause times are repeated while the signal input to terminal TRIG IN is TTL High or while the <ENTER> is pressed (and held).

③ When [BURST] is selected, program read is executed at the rising edge of the signal applied to terminal TRIG IN or when the <ENTER> key is pressed. The pause time value is ignored.

4.8 SET UP

① The setup is used for the configuration of communication parameters. The screen below appears when the <SET UP> key is pressed.

```
SET UP:
RS232C GPIB EXIT
```

②When RS-232C is selected, the following screen is displayed.

Select the baud rate of RS-232C using the rotary knob and confirm with the <ENTER> key.

(2400, 4800, 9600, 19200, 38400, 57600)

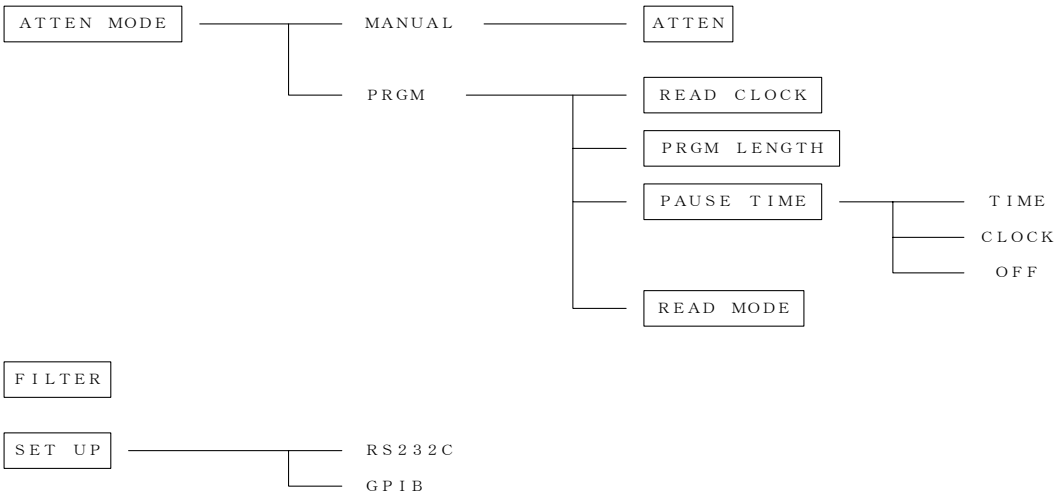
```
SET UP - RS232C
BaudRate: 57600
```

③When GPIB is selected, the following screen is displayed.

Select the GPIB address (0 - 30) using the rotary knob and confirm with the <ENTER> key.

```
SET UP - GPIB
ADDRESS: 10
```

4.9 Setup menu table



4.10 List of abbreviations

ATTEN · · · · · · · · · · Attenuator

PRGM · · · · · · · · · · · · Program

Trig · · · · · · · · · · · · Trigger

Sync · · · · · · · · · · · · Synchronize

5. Software for creating attenuation profiles

5.1 Minimum system requirements

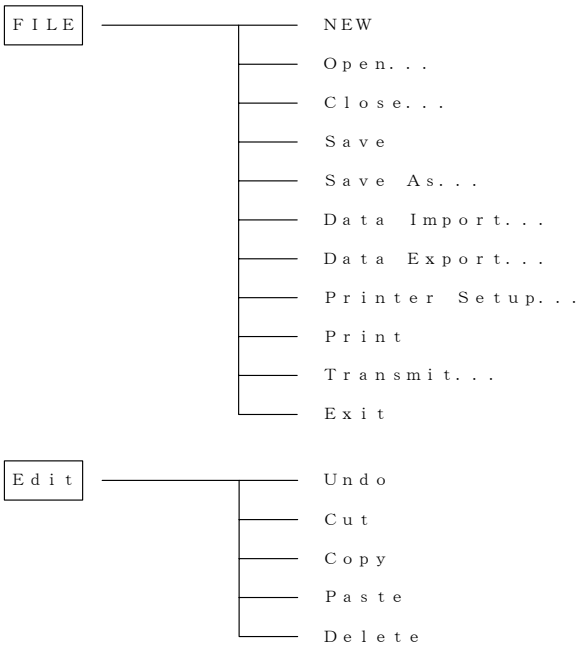
- Windows PC with Windows 98/NT/2000/XP/Vista
- CD-ROM drive
- RS-232C port (for data transfer)

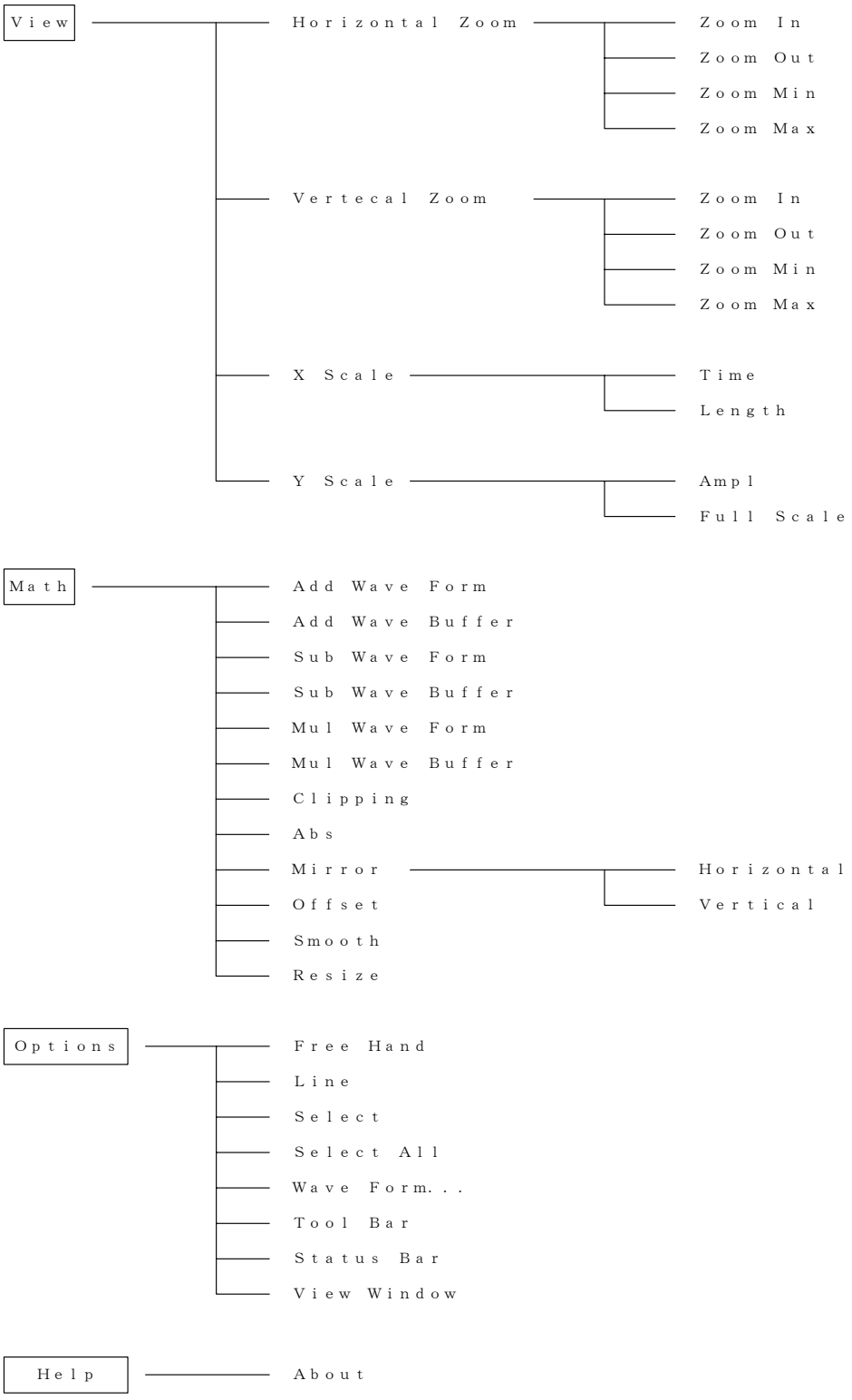
5.2 Installation and start-up

① Start SETUP.exe contained on the CD-ROM. The setup utility will start. For installation, follow the on-screen instructions.

② Start MAS800.EXE. The attenuation program software will be launched

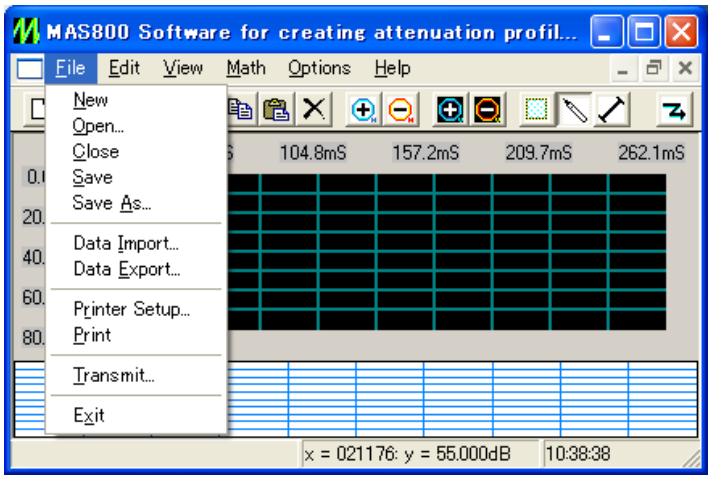
5.3 Menu structure




View
Horizontal Zoom
Zoom In
Zoom Out
Zoom Min
Zoom Max
Vertecal Zoom
Zoom In
Zoom Out
Zoom Min
Zoom Max
X Scale
Time
Length
Y Scale
Ampl
Full Scale
Math
Add Wave Form
Add Wave Buffer
Sub Wave Form
Sub Wave Buffer
Mul Wave Form
Mul Wave Buffer
Clipping
Abs
Mirror
Horizontal
Vertical
Offset
Smooth
Resize
Options
Free Hand
Line
Select
Select All
Wave Form...
Tool Bar
Status Bar
View Window
Help
About

5.4 Operation

(1) File



- New

Open a new edit screen.

- Open

Read the attenuation waveform data from a File and display it in the edit screen. The file format is binary.

- Close

Close the edit screen.

- Save

Save the attenuation waveform data to a binary file

- Save As…

Save the attenuation data with a specified file name (binary file)

- Data Import…

Read the attenuation waveform data from a text file and display it on the edit screen. The attenuation data must be formatted as illustrated in the following example:

Example: 1000 kHz sampling clock (program readout), length = 10 points

SAMPLING = 1.000KHz,,

20.00dB,20.00dB,20.00dB,20.00dB,20.00dB,60.00dB,60.00dB,60.00dB,

60.00dB,60.00dB,

- Data Export…

Save the waveform data to a text file.

- Printer Setup…

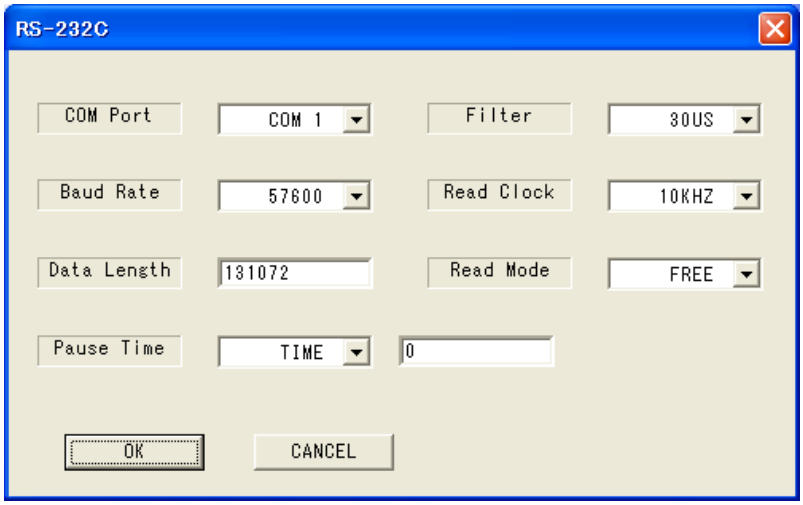
Set up of the printer.

- Print

Print the edit screen.

- Transmit…

Transfer the attenuation data to the 6010/6011/6012/6013



- COM Port

Configure your PC's COM Port

- Baud Rate

Select the baud (transfer) rate.

- Data Length

Set the data size to be transferred (8 – 131072 words).

- Filter

Select the attenuator switching response time.

- Read Clock

Select the program memory read clock rate.

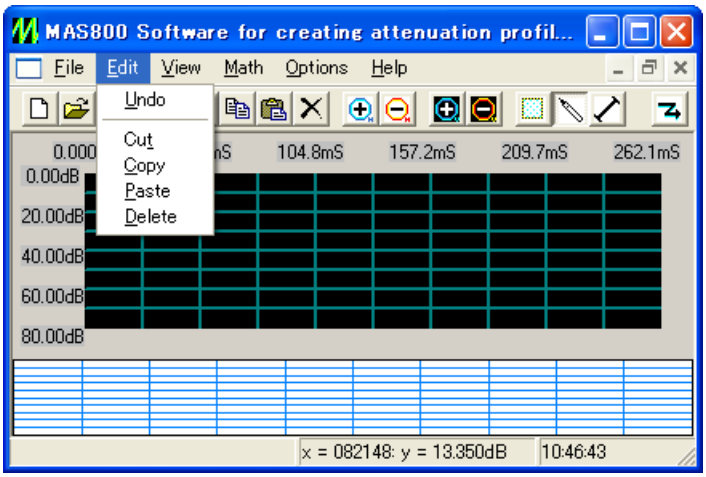
- Read Mode

Select the program read mode.

- Pause time

Select and set the pause time between readout periods.

(2)Edit



- Undo

  Cancel the previous action.

- Cut

  Cut the selected data to the buffer.

- Copy

  Copy the selected waveform data to the buffer.

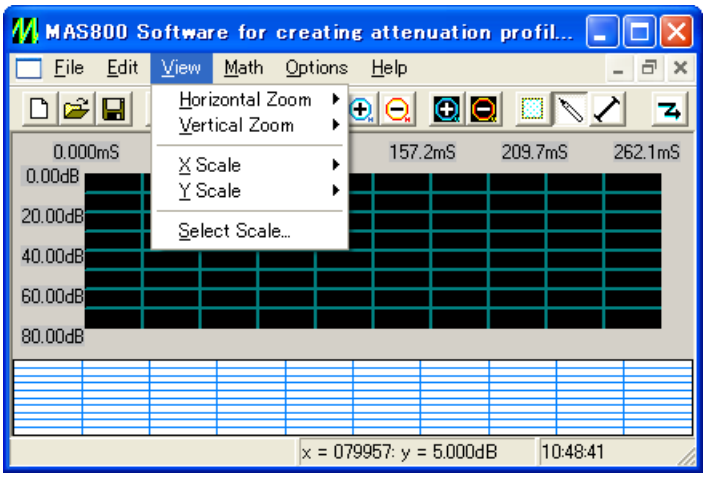
- Paste

  Paste the cut or copied data in the buffer to the selected position.

- Delete

  Delete the selected data.

(3)View



- Horizontal / Vertical Zoom

Enlarge or reduce the horizontal axis, with the left end of the screen as the reference.

Zoom In --- Enlarge

Zoom Out --- Reduce.

Zoom Max --- Maximum zoom

Zoom Min --- Show complete time base (no zoom)

Enlarge or reduce the vertical axis, with the center of the screen as the reference.

Zoom In --- Enlarge

Zoom Out --- Reduce

Zoom Max --- Maximum zoom

Zoom Min --- Show complete 0-80 dB scale (no zoom)

- X Scale

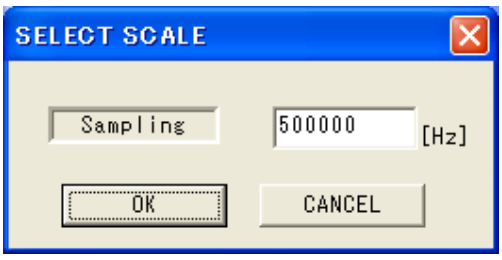
Toggle the units of the horizontal axis between time and number of data points.

- Y Scale

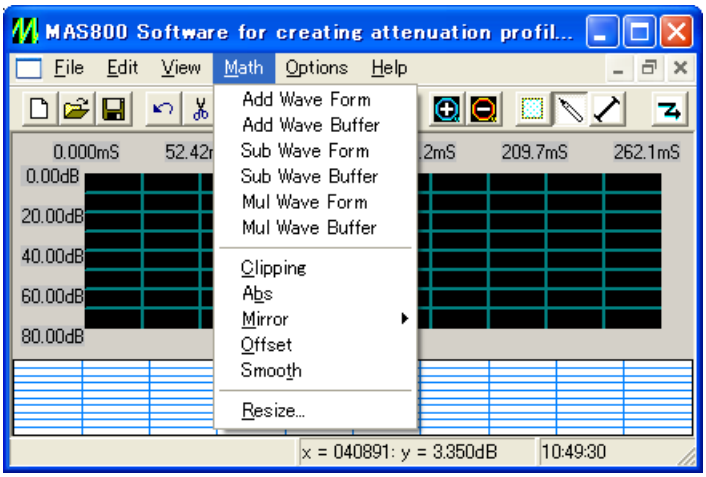
Toggle the units of the vertical axis between dB and % of full scale.

- Select Scale

Change setting of scale in Hz (readout clock frequency)



(4)Math



- Add Wave Form

Add a standard waveform, to the wave form in the editing window.

- Add Wave Buffer

Add the cut or copied data in the buffer to the specified waveform.

- Sub Wave Form

Subtract a standard waveform from the wave form in the editing window

- Sub Wave Buffer

Subtract the cut or copied data in the buffer from the specified waveform.

- Mul Wave Form

Multiply a standard waveform with the waveform in the editing window

- Mul Wave Buffer

Multiply the cut or copied data in the buffer with the specified waveform.

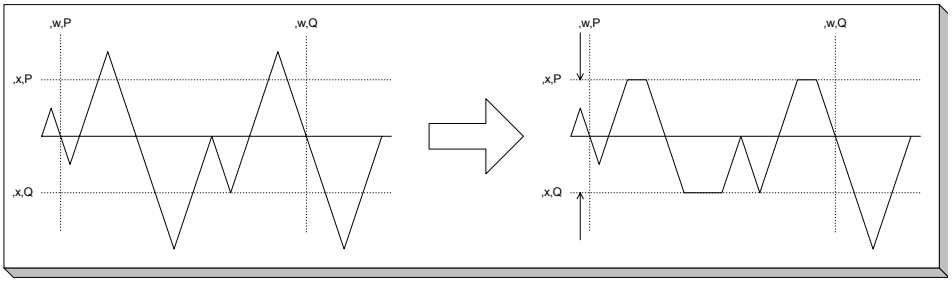
To perform the above Add/Subtract/Multiply operations, do the following:

a) Select the mathematical operation you want to perform

b)Using the mouse, highlight the area of the waveform in the editing window to which you want to apply the selected operation.

-Clipping

Limit (clip) the waveform to the limit points (Y1, Y2) within the horizontal range defined by (X1, X2)

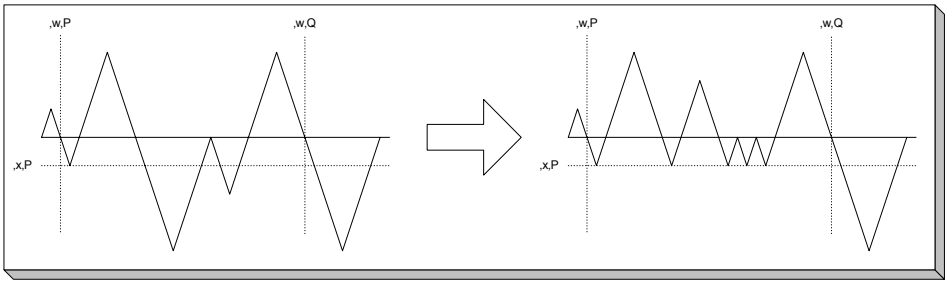


The waveform before and after clipping

To perform this operation: Select Clipping. Click on the waveform in the editing window, press and hold the left mouse key, define a horizontal line then release the mouse key.

- Abs (absolute value)

Apply the operation abs(f(x)) to the graph f(x) between X1 and X2

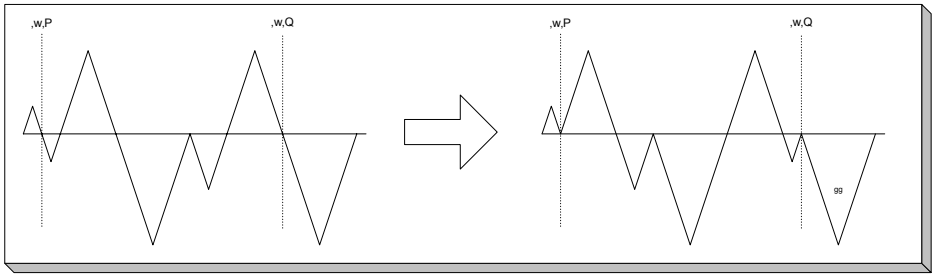


The waveform before and after applying the abs (fx(x)) operation

To perform this operation: Select Abs. Click on the waveform in the editing window, press and hold the left mouse key, define a horizontal line then release the mouse key.

- Mirror/Horizontal

On the graph f(x) between X1 and X2, reflect f(x) about a vertical line located at X1 + ½*(X2-X1)

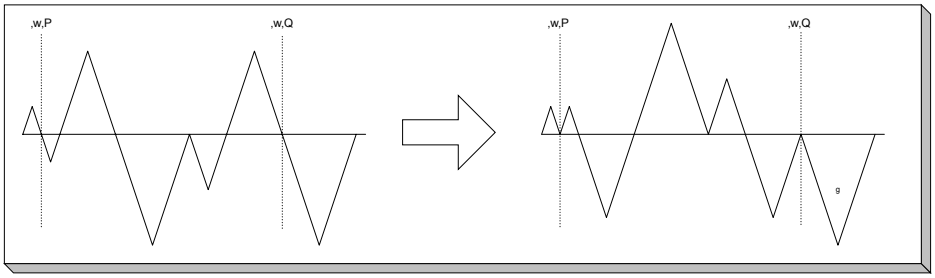


The waveform is being reflected about a vertical line

To perform this operation: Select Mirror/Horizontal from the menu. Click on the waveform in the editing window, press and hold the left mouse key, create a white space centered around the vertical line and release the mouse key

- Mirror/Vertical

On the graph f(x) between X1 and X2, reflect f(x) about a horizontal line

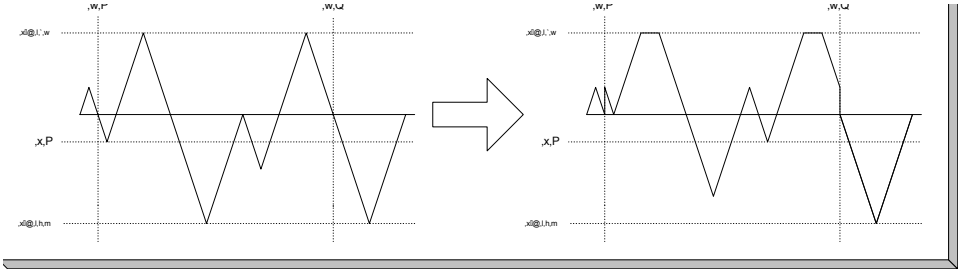


The waveform is being reflected about a horizontal line (x-axis)

To perform this operation: Select Mirror/Vertical. Click on the waveform in the editing window, press and hold the left mouse key, define a horizontal line then release mouse key

- Offset

Bring the range (X1, X2) between 2 specified points in the horizontal direction to the end point (Y1) in the vertical direction. You may see clipping if the offset is too large.

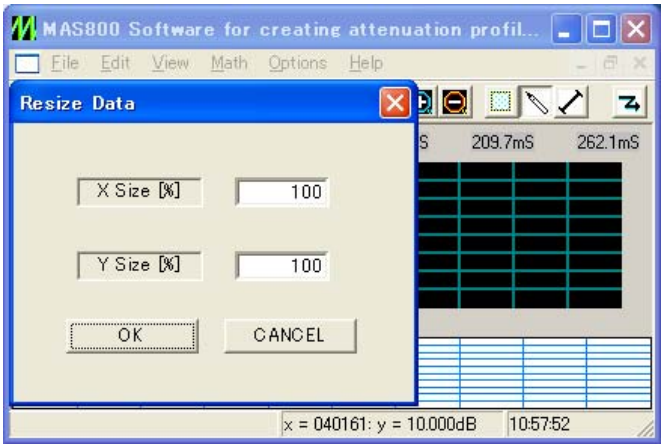


Apply offset to waveform

To perform this operation: Select Offset. Using the mouse, describe a square area around the waveform, working your way from the bottom to the top of the screen. The height of the square defines the offset value applied to the curve within the width of the square box

- Resize

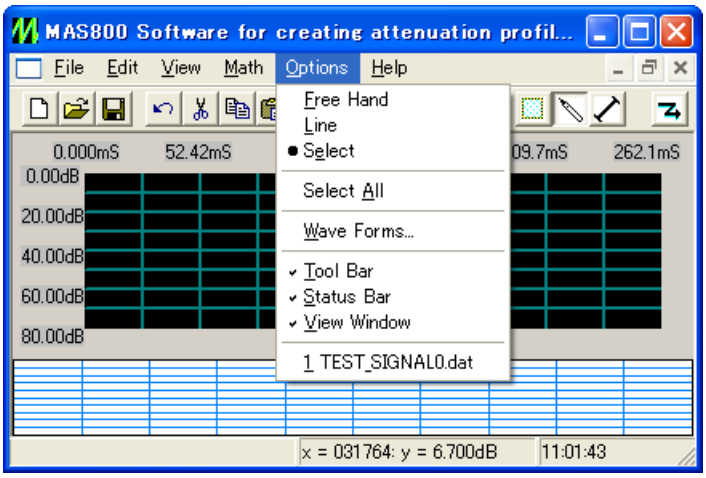
Resize the data along the vertical or horizontal axis by selecting a value between 0 - 99.9%.



The data will be compressed according to the factor selected.

Example: The maximum amplitude of a sine wave profile is 20dB. By selecting 50 for the Y size, all amplitude values will be decreased by 50% and the maximum amplitude will be 10 dB. The time axis will be adjusted accordingly

(5) Option



- Free Hand

This mode is for free-hand drawing of attenuation profiles. Press and hold down the left mouse button to draw. Drawing terminates when the mouse button is released. The free hand waveform is automatically connected to the existing waveform.

Or: Modify an existing waveform by clicking on the waveform, then dragging it to a new area.

- Line

Draw straight lines by clicking in the waveform window once, then move the cursor and left click again. Drawing terminates when the mouse button is released. The straight line waveform is

automatically connected to the existing waveform.

Or: Modify an existing waveform by clicking on the waveform, then dragging it to a new area.

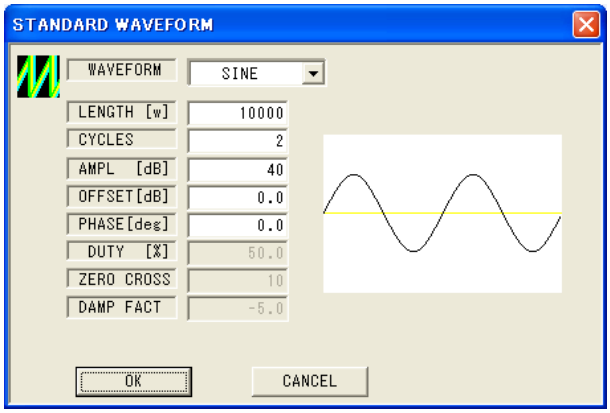
- Select

Select a portion of the wave that is the object of the edit or arithmetic operation.

- Select All

The entire waveform is selected.

- Wave Forms



Create a standard waveform. It cannot be created unless the waveform window is open. The standard waveforms are:

SIN	Sine wave
SQUARE	Square wave
TRIANGLE	Triangle wave
RAMP	Synchronizing
SIN(X)/X	Sinc function
EXP RISE	Exponential rise
EXP FALL	Exponential fall
DC	DC voltage

Parameter	Setting range	Applicable waveform
LENGTH [W] (number of data)	8 – 131072	All waveforms
CYCLES (cycle)	1 – 100	All except DC
AMPL [dB] (amplitude)	0 – 80 dB	All waveforms
OFFSET [dB] (offset)	0 – 80dB	All except of DC
PHASE [deg] (phase)	0 – 360°	All except of DC
DUTY [%] (duty cycle)	0.01 – 99.99%	SQUARE and TRIANGLE
ZERO CROSS	0 – 100	Sin(X)/X
DAMP FACT (attenuation)	-15 - +15	EXP RISE and EXP FALL

Select whether or not to select the toolbar. Icons in the tool bar correspond to the following menu.

File: New

File: Open

File: Save

Edit: Undo

Edit: Cut

Edit: Copy

Edit: Paste

Edit: Delete

Zoom in horizontally

Zoom out horizontally

Zoom in vertically

Zoom out vertically

Option: Select

Option: Free Hand

Option: Line

File: Transmit

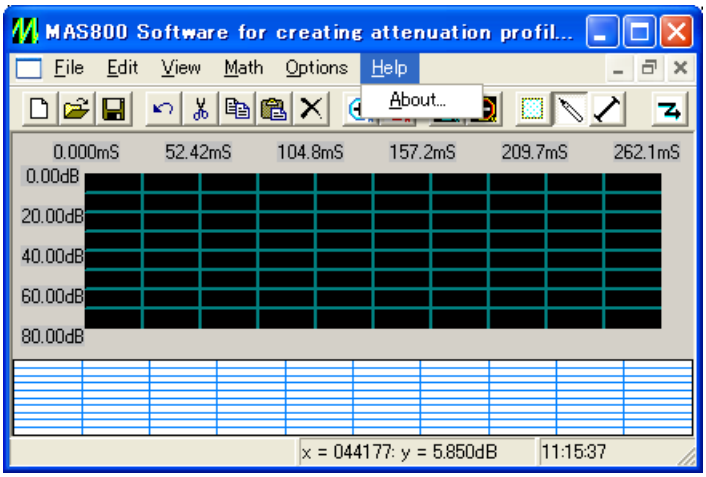
- Status Bar

  Toggle the display of the status bar. When the status bar is displayed, the current grid point and the time appear underneath the screen.

- View Window

  Turn the display of the bottom window on/off. This window always shows the complete waveform and is useful as a reference when manipulating the waveform in the main window.

(6) Help



- About

The program’s version information is displayed.

6. Remote interface

6.1 RS232C protocol

Configuration of RS232 interface:

Transfer rate:	2400/4800/9600/19200/38400/57600
Stop bit:	1 bit
Character length:	8 bits
XON-OFF:	None
Parity:	None

Note: The supplied R232C cable is configured as cross or null-modem over cable

Command syntax and protocol

See section 6.3 for a complete list of commands. A command consists of the ASCII letters for the command and a data part. There is no blank between the command and the data part. Some commands do not contain a data part. The data parts are ASCII characters. All commands must be terminated with CRLF (carriage return/line feed).

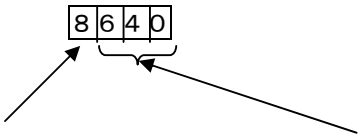
The transmission of each command must be preceded by a “CY” handshake. The computer program must send the ASCII character 'C' to the 6010. Then the 6010 attenuator responds by sending 'Y' followed by CRLF. Only after successful exchange of this handshake will a command be accepted by the attenuator. Upon receipt of a valid command, the 6010 responds with a string “OK”, followed by CRLF. The sequence for a command transmission is:

PC		**6010**
"C"	------>	
	<------	"Y"+CRLF
"RCL1KHZ”+CRLF	------>	
	<------	"OK"+CRLF

Download command DLxxxx

The DLxxxx command can be used to transfer a block of arbitrary attenuation data to the instrument using a single command. xxxx is a decimal value between 8 – 131071 and denotes the length or number of attenuation data points to be transmitted. The attenuation data will be transmitted immediately following the DLxxx command. As with the other commands, the DLxxxx command must be preceded by a “CY” handshake. The data are terminated by CRLF and the attenuator will acknowledge receipt of the data with ‘OK’. If data transmission was unsuccessful, the instrument will respond with ‘ERR’.

Each attenuation value is represented by one 16 bit word. The hexadecimal code for this word is coded as followed:



Controls the SyncOut	Attenuation value: three Hex digits.
8h: Sync pulse TTL High	Conversion: = Real ATT level(dB)／0.05
Fh: Sync pulse TTL Low	1h represents 0.05dB, 640h represents 80dB
Other values are not used	

Each data word is transferred in the order of Low Byte first, High byte second. 80dB or 8640h would be transmitted as 4086h. (Note: h denotes hexadecimal value)

Sequence for transmission of an arbitrary waveform data block:

PC		**6010**
"C"	------>	
		<-- "Y"+CRLF
"DL10;"	------>	
		<-- "Y"+CRLF
10words { 8064, 80C8, 8064, 80C8, 8064, F0C8, F064, F0C8, F064, F0C8 }	⇨	Actual transfer: 6480h, 80C8h…
CR LF		
"C"	------>	
		<-- "Y"+CRLF
"LEN10”+CRLF	---->	
		<-- "OK"+CRLF

In this example, the attenuation level toggles between 5 dB and 10dB for 10 times. Assuming that the sample clock was set to 1KHZ, each value is held for 1ms and the total execution time is 10ms. The Sync pulse will be TTL: high during the first 5ms and TTL low during the last 5ms.

6.2 GPIB protocol

The command syntax and protocol is identical to the RS232 interface except for the “CY” handshake,

which is not used. CRLF (EOI) is transmitted as a termination string.

6.3 Command list

Command	Data part	Explanation
MAN	---	The control mode of the attenuator is set to MANUAL
PRG	---	The control mode of the attenuator is set to PROGRAM
ATT	0.00 – 80.00	Set the attenuation level when in MANUAL mode.
FLT	1US, 3US, 10US, 30US, 100US, 300US, 1MS, 3MS	Change filter constant (units are in μs and ms).
RCL	MANU, EXT, 100HZ , 200HZ, 500HZ, 1KHZ, 2KHZ, 5KHZ, 10KHZ , 20KHZ, 50KHZ, 100KHZ,200KHZ , 500KHZ	Set the program read clock.
LEN	8 – 131072	Set the program length.
PTI	0.000S – 6.5535S	Set the pause time. If PTI is not set, this parameter will automatically be set to zero (no pause time)
PCL	0 – 65535	Set the pause time is in number of clocks. If PCL is not set, this parameter will automatically be set to zero (no pause time)
POF	---	Pause period is turned off (identical to setting PCL or PTI to zero).
MOD	FREE BURST GATE	Specify how the program is triggered.
RMT	---	When the instrument is set to remote mode, it cannot be operated from the front panel. Push the "ENTER" key to return to local mode.
DL	xxxx;	Configure the length of the data block to be transferred to the instrument. xxxx should generally be set to the same value as the LEN parameter, however it is possible to set LEN to a value equal or less than xxxx

6.4 Example program

Below is a code sample created with Visual Basic 6.0. The complete Visual Basic project, including the executable, can be downloaded from the B+K Precision website at www.bkprecision.com.

```
Dim CrLf As String
CrLf = Chr$(&HD) + Chr$(&HA)
Dim Buffer(1) As Byte


******* transmit DL8 command to prepare for transmission of 8 word data block ****
*******Function Call WaitRes() receives 3 bytes, in this case 'Y'+ CRLF      **********
MSComm1.Output = "C"
Call WaitRes(3)
MSComm1.Output = "DL8;"
Call WaitRes(3)


**** transmit 8 attenuation values of type word **********
**** set the Sync pulse, move high byte to low byte and low byte to high byte position *****
For i = 1 To 8
      If Check1(i) = 1 Then sync = "8" Else sync = "F"
            s = sync + Right$("000" + Hex$(TextATT(i) / 0.05), 3)
            Buffer(0) = Val("&h" + Left(s, 2))
            Buffer(1) = Val("&h" + Right(s, 2))
            For j = 1 To Word(i)
                  MSComm1.Output = Buffer
            Next
Next
MSComm1.Output = CrLf


******set the program length to 8 **************
**Function Call WaitRes() receives 3 and 4 bytes respectively, in this case 'Y'+ CRLF and OK'+ CRLF*
Call WaitRes(4)
MSComm1.Output = "C"
Call WaitRes(3)
MSComm1.Output = "LEN" + CStr(dl) + CrLf
Call WaitRes(4)
```

Service Information

Warranty Service: Please return the product in the original packaging with proof of purchase to the address below. Clearly state in writing the performance problem, how to recreate it, and return any leads, probes, connectors and accessories that you are using with the device.

Non-warranty Service: Return the product in the original packaging to the address below. Clearly state in writing the performance problem, how to recreate the problem, and return any leads, probes, connectors and accessories that you are using with the device. Customers not on an open account must include payment in the form of a money order or credit card. For the most current repair charges please visit www.bkprecision.com and click on "service/repair".

Return all merchandise to B&K Precision Corp. with pre-paid shipping. The flat-rate repair charge for Non-Warranty Service does not include return shipping. Return shipping to locations in North American is included for Warranty Service. For overnight shipments and non-North American shipping fees please contact B&K Precision Corp.

B&K Precision Corp.
22820 Savi Ranch Parkway
Yorba Linda, CA 92887
www.bkprecision.com
714-921-9095

Include with the returned instrument your complete return shipping address, contact name, phone number and description of problem.

Limited One-Year Warranty

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof will be free from defects in workmanship and materials for a period of one year from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, a defective product or component parts. The returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing a warranty registration form on www.bkprecision.com within fifteen (15) days of purchase.

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B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

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